

I External Ear

1. **Ear Pinna** = Funnel shaped elastic cartilage, covered on both sides by skin

2. **Ext. auditory meatus**:

- It's outer $\frac{1}{3}$ is the continuation of the auricle so, supported by elastic cartilage. It's inner $\frac{2}{3}$ is a bony canal.
- lined e' skin e' hair follicles, sebaceous & Ceruminous glands [apocrine sweat glands] → cerumen = yellowish oily/waxy contains ptns., FAs., sloughed Keratinocytes. Funct²: protective & antimicrobial.

3. **Ear drum [tympanic memb.]**

= 2 ls of collagen fs (inner circ. & out. radial) + elastic fs + fibroblasts.

It's outer surface is covered e' stratified squamous epith. &

„ inner „ „ „ „ simple cuboidal „

It's anterosuperior quadrant is flaccid & transparent (e' no collagen fibres & called **Shrapnel's membrane** [Pars Flaccida].

Perforation of tympanic memb. → transient or permanent defective hearing.

II Middle Ear

Air filled cavity in the temporal bone. lined e' s. cub. epith.

It's **lat. wall** = ear drum.

It's **med. „** is in contact e' the inner ear via the round & oval windows.

The Oval window: closed by the foot of stapes. transmits vibrations of ear drum to perilymph in inner ear.

The round „: closed by elastic memb. (2^{ry} tympanic memb.) & dissipates sound waves after stimulating the receptors

Posteriorly: continuous e' mastoid cavities of mastoid air cells.

Anteriorly: connected to nasopharynx by Eustachian (auditory) tube.

It contains:

1. **Bony Ossicles (3)**: Malleus, Incus & Stapes.

The handle of malleus is attached to the tympanic memb. while the foot of stapes fits into the oval window. They articulate by synovial joints & covered e' s. cub. epith.

2. **Muscles**: Tensor tympani inserted into the malleus & stapedius inserted into stapes.

They regulate conduct² of sound. loud sounds → reflex contract² to limit vibration of the ear drum & stapes & prevent damage of recepto

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3. Chorda tympani.

Conductive Deafness: is due to diseases of ext. aud. canal, ear drum or ossicles.

The Eustachian tube: (auditory tube)

- 4 cm long. Connects middle ear to the nasopharynx.
- Opens during yawning or swallowing to equalize pressure on both sides of ear drum. - lined e' ps. st. col. cil. epith. Goblet cells are present only in $\frac{1}{5}$ of it.
- At the pharyngeal side, a tubal tonsil is present.

Otitis media: infection spread from the nasopharynx to the middle ear via auditory tube.

III - Inner Ear

a - Bony Labyrinth:

1. Cochlea.
2. Vestibule
3. Semicircular canals.

Filled e' perilymph (e' high Na^+ & low K^+) $\xrightarrow{\text{drain into}}$ subarchnoid space.

b - Membranous labyrinth:

inside the bony labyrinth includes:

1. Cochlear duct.
2. Utricle & saccule
3. membranous semicircular canals.

Filled e' endolymph (e' low Na^+ & High K^+) $\xrightarrow{\text{drain into}}$ Dural venous sinuses.

A. The Cochlea

- A bony tube w makes $2\frac{1}{2}$ turns around a central bony axis called **modiolus** = spongy bone w contains: bl. vs, nerve fibres & spiral gang.
 - A bony projection = **spiral lamina** extends from the modiolus into the lumen of the cochlear tube.
 - The periosteum of the outer bony wall of cochlea is thickened $\rightarrow$ Spiral ligament.
 - The basilar memb. extends from the spiral lamina to spiral lig. & carry Organ of Corti.
 - The vestibular memb. extends " " " " to wall of cochlea.
 - The bony cochlea appear as 5 cavities around the modiolus. each cavity is subdivided into:
 1. **Scala Vestibuli**: above the vestibular memb. contains perilymph.
 2. **Scala Media** = Cochlear duct, contains endolymph.
 3. **Scala tympani** = below basilar memb. contains perilymph.
- Both, scala vestibuli & scala tympani are lined e' s. sq. epith.

The Cochlear duct:

- 3 -

- Triangular space filled w' endolymph & conned to the saccule
- It's floor = Basilar memb. = s. sq. epith. & b.m.
- It's roof = Vestibular " " " = 2 layers of s. sq. epith. joined by tight junctions to preserve high ionic gradient bet. perilymph in scala vestibuli & endolymph in the cochlear duct.
- It's lat. wall = Stria Vascularis = ps. st. col. epith (unusually vascular + vascular c.t. It forms the endolymph. The cells have basal infoldings → K^+ pump into the cochlear duct in the form of endolymph.

Organ of Corti

Neuroreceptor for hearing, on the basilar memb inside Cochlear duct. Formed of:

(1) Hair [Sensory] Cells:

- a. Inner hair cells: 1 row supported by inner phalangeal cells.
- b. Outer " " : 3-4 rows " " outer " " " "

Both inner & outer cells are provided w' long microvilli (Stereocilia) that act as receptors. Their bases are provided w' nerve endings = dendrites of bipolar nerve cells of spiral ganglia. The apical stereocilia are embedded in a gelatinous memb. called Tectorial Membrane [= glycoprotein + collagen bundles]

(2) Supporting Cells:

a. Inner & outer phalangeal Cells:

- They rest on the basilar memb. & directly support the hair cells.
- The out. phalangeal cells form 3-4 rows & each have cup shaped apex w' surround the basal $\frac{1}{3}$ of the outer hair cells & extends one phalanx w' is joined to the hair cell by junctional complexes.
- The inner phalangeal cells form one row w' completely surround the inner hair cells.

b. Inner & outer pillar cells :

-4-

The outer cells have upper expanded end w fits into the upper concave end of the inner cells & form boundaries of **Tunnel of Corti**. They contain **Keratin bundles** → cytoskeleton (support)

c. **Hensen's Cells**: tall col. cells adjacent to out. phalangeal cells.

d. **Cells of Claudius**: short " on the out. edge of organ of Corti.

e. **Border Cells**: support the inner side of organ of Corti.

Neural deafness: due to loss of hair cells of organ of Corti or degeneratⁿ of the cochlear nerve. treated by cochlear implants.

B. The Vestibule

- A bony cavity containing the utricle & saccule
- Both are formed of c.t. lined e' s. sq. epith. They are connected to the periosteum by c.t. strands.
- They have neuroepith. structures called **macula** (تشعشع)
- Macula of saccule is perpendicular to the macula of utricle.

C. The Semicircular Canals

- 3 bony semicircular canals w contain 3 membranous canals surrounded e' perilymph & attached to the bony canals by c.t. strands.
- Each canal has a dilated end called **ampulla**. It contains neuroepith. structure called **Crista ampularis**. (تشعشع)

Macula (utriculi & sacculi)	Crista ampularis
Hair Cells = mechanoreceptors e' apical stereocilia (e' actin core) + 1 true cilium = Kinocilium (e' basal body). Type I (flask shaped) + type II (cylindrical)	
Supporting cells Col. cells e' basal oval nuclei. present bet. the hair cells. Have apical microvilli	
Covered e' thick gelatinous glycoprotein memb. contains CaCO₃ crystals called Otolithic memb.	Formed by the supporting cells has no CaCO₃ crystals called Cupula & thicker
Function register linear acceleration & deceleration of the head.	register rotational acceleration.

Defective vestibular apparatus → Vertigo
Overstimulation of macula → motion sickness.